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ABSTRACT

The impact of the computer on education may be greater than the impact of any other technological innovation since the development of the printing press. Although distance education has relied more extensively on technological means for delivering education to its students than has traditional classroom-centered education, most distance programs use technology only to the extent that different modes of transmitting education are required by circumstances. Major efforts to use broadcast media, satellite transmission, or computer networking as basic modes of delivery have been limited to schools where distance education is the central emphasis. In most other cases, including the University of Waterloo in Ontario (where the administrative uses of computers and the extent of computer education efforts have been particularly important), costs and logistics have limited efforts to design and produce computer-based instructional delivery systems for off-campus students. Areas in which such effots can be expected to bear fruit first include the speeding up of communication between students and schools, and the introduction of computer education courses relying on student-owned equipment. In any case, the technology should not serve as a reason to change delivery systems, but as a means for doing so. (PGD)

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TECHNOLOGY AND DISTANCE EDUCATION*

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Technology and Higher Education

According to Eric Ashby, higher education has experienced three "revolutions" in its lifetime, and is currently in the midst of a fourth. The first three revolutions involved the establishment of the formal school, the creation of writing, and the invention of the printed book. Like the third (and perhaps the second) revolutionary developments in education, Ashby's fourth revolution involves a change brought about by technology -- in this case the computer. Writing two decades ago he foresaw computers making vast changes to the way education is organized and delivered. Such effects had been wrongly predicted with respect to other technologies (a prime example might be educational television), and the changes Ashby foresaw were slow to take hold. However, the past ten years has been a period of unprecedented growth and development in computer technology, exemplified not only by the widespread availability of cheap and powerful microcomputers, but also by the marrying of computers and electronic communication devices. It is this link between the data storage and handling capacity of the computer and facilities for the rapid and inexpensive transmission of data over vast distances that has given birth to the new "information technology". It has been claimed that information technology will be the force to transform universities and colleges and revolutionize education.

The Special Case of Distance Education

Distance education has always made use of media -- from print to satellite television -- to deliver instruction. Indeed it might be argued that distance education, almost by definition, relies on some form of technology, however crude, to reach its students. Not surprisingly, the revolutionary claims made for the new information technologies have also been heard with respect to distance learning, where at first sight the potential for technological innovation seems considerable. However, before embracing any new method of delivering instruction at a distance, it is probably wise to ask some fundamental questions about the goals of distance teaching and examine the constraints on achieving those goals in relation to different instructional approaches.

Several years ago Wilbur Schramm made an important distinction between "big" and "little" media and technologies for educational communication. While many successful applications for distance teaching in the past have emphasized the former (for example, print and audio cassettes), there have also been some very notable uses of "big" media in individual institutions. These include the British Open University's television programmes and the University of the South Pacific's satellite broadcasts. What seems clear, however, is that the effective use of technology

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depends in large measure on the instructional circumstances, and that the most modern technology is not necessarily the best for all institutions and all students.

The University of Waterloo, Information Technology, and Distance Teaching

The University of Waterloo is a relatively new Canadian university that has a considerable reputation for making sophisticated use of technology, especially computers. Waterloo has, almost since its inception, made extensive use of computers for administrative tasks and in its research programmes. The institution has developed and marketed world-wide a variety of software, such as the WATFOR and WATFIV compiler languages, the SCRIPT text processing system, the JANET system for networking microcomputers, and so on -- software that is now successfully marketed through a university-related commercial subsidiary. Partly because of its reputation in software development, Waterloo has recently embarked on some massive collaborative projects with major computer manufacturers, including IBM and DEC, that involve donations of equipment worth many tens of millions of dollars. Use of computers for routine office work is common, and it is estimated that well over half the secretarial staff have computing skills. There is also extensive provision for student access to computing facilities. At any one time, there are approximately 9,000 students taking one or more classes involving the use of the computer; by the time they graduate, 90% of Waterloo students will have completed at least one computing course.

At the same time, there is only modest use of technology in the actual delivery of instruction at Waterloo. Most courses employ relatively conventional lectures and laboratories, television is used primarily as an instructional aid, and the most common teaching innovation is project work involving problem-solving approaches. Although students receive extensive hands-on experience with computers these are used almost exclusively to teach computing skills -- such as programming -- or as tools for such tasks as statistical calculation, word processing, data-base management, spreadsheet applications, computer graphics and computer-aided design, with virtually no computer-assisted instruction in the conventional meaning of that term.

Use of Technology in Waterloo's Distance Education Programme

The University of Waterloo has one of the largest distance education programs in North America, with some 6,000 students enrolled in over 200 credit courses. Here again, despite the University's reputation for involvement with sophisticated technology, applications fall almost entirely within Schramm's concept of "little media". Since its inception in 1968, the Waterloo Correspondence Program (as it is still called) has made extensive use of audiotapes -- originally reel-to-reel, and now cassettes.

The original underlying premise for distance courses was to

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provide independent learning that could replicate the "on-campus experience" as closely as possible. Courses are prepared and taught by the same instructor who handles the equivalent Waterloo-taught course: a set of audiotapes is intended to replace the lectures (although these tapes are specially prepared and simply recording live classroom lectures is not acceptable), a set of course notes provides material that would be written on the blackboard or given as handouts, students are sent appropriate textbooks, there are regular assignments (essays, term papers, etc.), and a mandatory final examination is held at centres throughout the country.

Most Waterloo courses offered in distance mode fall within the area of the liberal arts (although some courses in computer programming are offered), and these are generally thought to be best served by delivery mechanisms that rely heavily on the printed and spoken word. Although it might be argued that material presented on audiotape could be reproduced in printed form, the cassettes have proved extremely popular with students, partly because they constitute an extremely flexible learning medium (students can listen in their cars, on the train, or even while jogging). Tapes also seem to provide a sense of personal contact with the instructor that print may lack. In addition to the set of some twenty taped lectures (which are generally unchanged throughout the four year life cycle of the course), cassettes can also be used for more informal exchanges between instructor and learners -- for example to provide comments on assignments, receive student queries, and gather brief autobiographical information that can be circulated to other members of the class. Where appropriate, various supplementary learning materials are provided, for example rock samples, fossil kits, chemistry molecule building kits, a lens for use in an optics course, a viewing lens for a cartography course, a simple analog computer for a physics course, microscopic slides, and a variety of 35 millimetre colour slides for use in courses such as theatre history. Although technologically fairly unsophisticated, the Waterloo approach is inexpensive (the basic package costs from $50 to $75 including notes, tapes, and some ancillary material) and, within a paced course structure, provides flexibility for the students in allowing choice of how and when they will study.

Given the nature of the University of Waterloo, it is not surprising that there is a continual discussion about possible ways of introducing new methods of delivery for distance courses and, in particular, examining possible applications of computer-based education for distance purposes. To this point there appears to be no great demand for new approaches, and indeed correspondence students appear to favour the very modest technology that has proved successful in the past. For example, recent experiments in audio teleconferencing have had rather little success in attracting students to take part in the optional course sessions offered by telephone. Ironically, although some students are eager for more contact with the instructor and fellow students in the course, others appear to like the relative anonymity of correspondence learning, and seem to resent what they see as interference with their personally convenient study schedules.

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One possibility that could allow interaction without imposing the constraints of time and place demanded by audio teleconferencing is to introduce some form of computer conferencing, and this is being considered, although the size of the Waterloo programme means that the cost of providing a service accessible to most students would be prohibitive. Discussions are presently taking place with the Council of Ontario Universities to explore ways of introducing computer conferencing on a collaborative basis by providing computing facilities in locations across the province to serve students from a variety of institutions. This in turn raises the question of whether it is equitable to introduce an innovation -- technologically-based or not -- that can serve only some students.

Perhaps more promising is the use of technology to enhance aspects of the programme that at present cannot be carried out as efficiently as might be desirable. Waterloo, in common with many distance education programmes that serve learners by mail, suffers from a quite lengthy delay in returning marked assignments to students, which can have serious consequences for providing appropriate feedback and sustaining motivation. Computers might be of great help here, not only in actually marking assignments, but also possibly in "delivering" assignments and tests, as well as the correct answers, to the student's home by electronic means. At the moment this is technologically feasible, but logistically impractical, however.

Finally, there will no doubt be an increasing demand for courses about underlying technology -- for example courses that attempt to provide so-called "computer literacy", deal with the social impacts of technology, and so on. Such courses will almost certainly be offered in distance mode, and it seems reasonable that some means will have to be found to provide distance learners with computing experience in their own homes. This path has already been pioneered by the British Open University, which went so far as to develop its own computer in conjunction with the BBC. At Waterloo there are tentative plans to use a new and powerful lap portable computer in selected distance courses, so as to explore a wide variety of possible applications with remote learners.

Conclusions

Because technology has an inherent glamour, it is perhaps not surprising that technological innovations in distance teaching have attracted worldwide attention to a form of education that has often gone unnoticed by the public, despite its considerable achievements over many years. Under such circumstances it is easy to attribute educational successes to the highly visible innovative medium involved, without recognizing other essential elements of the distance education system, such as sound course design, concern for students, careful monitoring and evaluation mechanisms, and so on may be the main elements in successful learning. It seems possible that -- to cite again two institutions mentioned above -- the Open University could function perfectly well without its television programmes, and that the courses offered by the University of the South Pacific

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will continue to be taught successfully even after the demise of the ATS-1 satellite.

In the case of Waterloo, despite its considerable reputation in the field of computing, technology has been used sparingly to deliver instruction, both in the on-campus and distance education programmes. Its caution in adopting new technologies -- especially what Schramm calls "big media" may be well placed as long as the institution remains in touch with relevant new developments and open to experiment with new approaches. However, in distance education, as with other forms of university teaching, care should be taken to ensure that technology does not drive the instructional process, but rather serves a genuine need that could not be better met by other means.